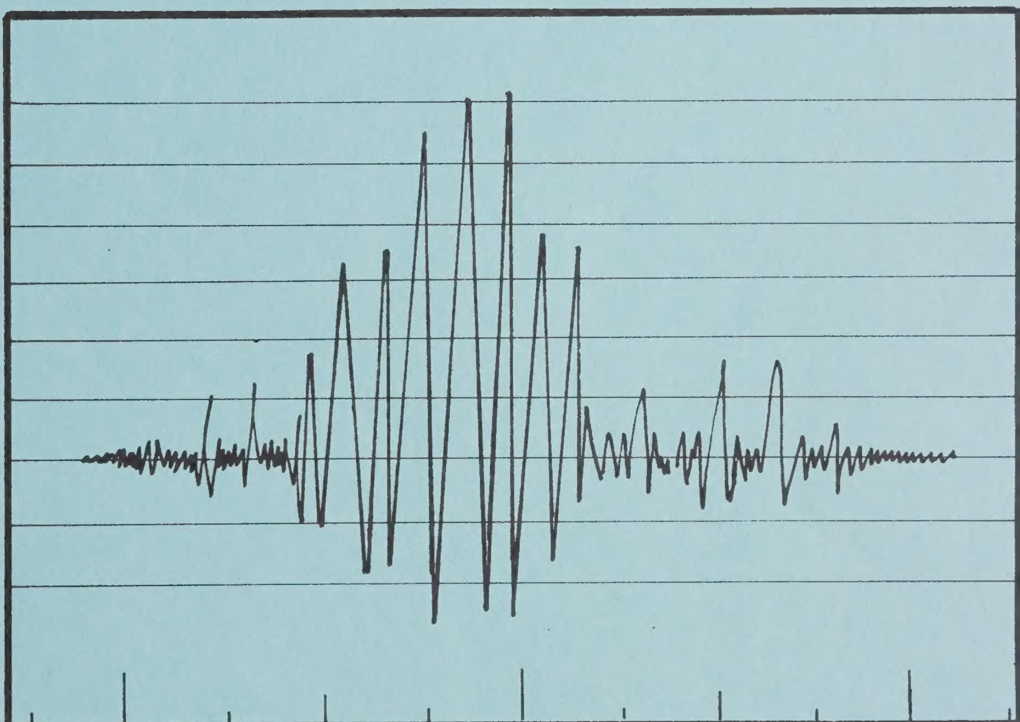

# CITY OF PLEASANT HILL
# SEISMIC SAFETY
## ADOPTED JUNE 14, 1982

RESOLUTION NO. 55-82

A RESOLUTION OF THE CITY COUNCIL, CITY OF PLEASANT HILL, ADOPTING THE SEISMIC SAFETY ELEMENT OF THE GENERAL PLAN

WHEREAS, the City Council, City of Pleasant Hill, on June 7, 1982, held a Public Hearing to receive comments on the proposed Seismic Safety Element as adopted by the Planning Commission on February 2, 1982, in accordance with Government Code Section 65302 (f) and Section 65350; and

WHEREAS, having reviewed all pertinent documents and heard testimony of interested persons the City Council finds the Seismic Safety Element to be acceptable.

NOW, THEREFORE, BE IT RESOLVED, that the City Council of the City of Pleasant Hill, hereby adopts the Seismic Safety Element of the General Plan.

ADOPTED by the City Council of the City of Pleasant Hill on the 7th day of June, 1982, by the following vote:

Ayes: Cooper, Mulhall, Weldon, Holmes

Noes: None

Absent: Mustard

Oliver L. Holmes

OLIVER L. HOLMES, Mayor

Attest:

Wetona L. Crawford

WETONA L. CRAWFORD, City Clerk

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# SEISMIC SAFETY



## INTRODUCTION

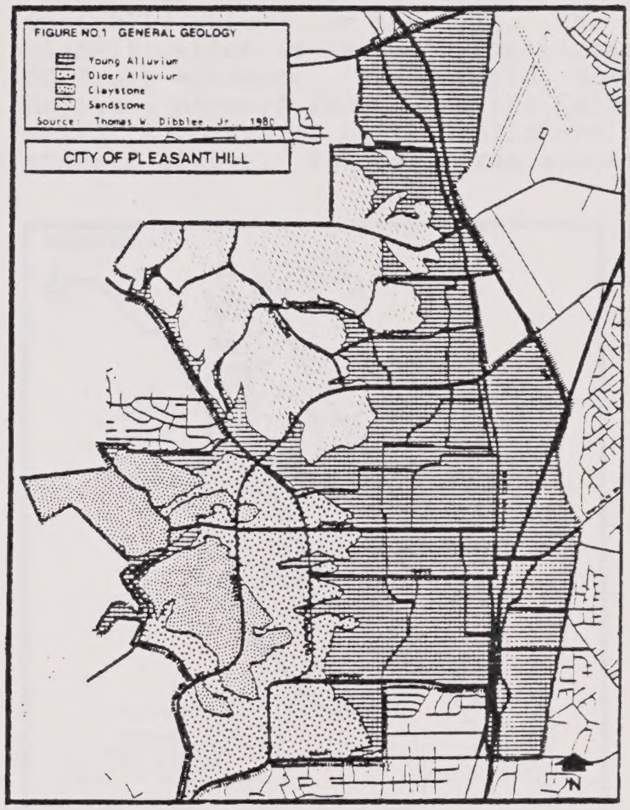
The State Legislature mandated each City and County in the State to prepare a "Seismic Safety Element" consisting of an identification and appraisal of seismic hazards, such as susceptibility to surface ruptures, ground shaking, ground failures or effects of seismically induced waves, such as tsunami and seiches.

This Element discusses and identifies seismic hazards in the Pleasant Hill Planning Area and provides a basis for developing a sound land use policy which reduces the potential loss of life, injury, and damage to property resulting from a major earthquake.

Almost any discussion of geological hazards requires an accurate description of the geology of the planning area under review. This Element attempts to provide such a description in the clearest terms possible, recognizing the purpose is to provide a basis for developing land use policy.

The City of Pleasant Hill Planning Area lies in the southwest quadrant of the Diablo Valley, a tectonic depression whose underlying strata is comprised of a series of folded sedimentary formations. The folds, along with the dominate faults, run in a northwestern direction.

The Pleasant Hill Planning Area consists of two general geological formations. First, there are the alluvium soils found in the relatively flat areas of the City. Alluvium is the eroded sediment deposited in stream and creekbeds, flat plains or lakes during relatively recent geological time. The erosion process is still occurring today, with additional siltation from the hills being deposited in the valley adding to the alluvium depth. The alluvium, in the planning area, consists of varying degrees of consolidated and semiconsolidated gravels, coarse to fine-grain sands, silts, and clays. It is estimated that alluvium depth in Pleasant Hill ranges from zero (presently forming) to over 150 feet in the oldest deposits. Figure No. 1 indicates the locations of the alluvium deposits in the Pleasant Hill Planning Area.



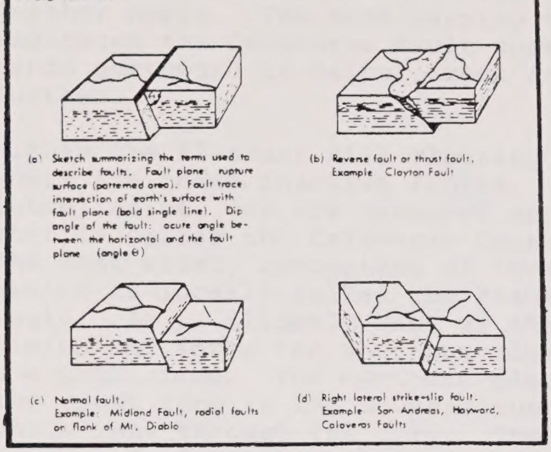

The second major geological feature is the bedrock (the rock formation directly under the soil) of the Briones Hills in the northern and western portions of the Pleasant Hill Planning Area (see Figure No. 1). The Briones formation is mostly comprised of finely-grained to coarse-grained sandstone with some claystone and siltstone. These formations derive their names from the size of the particles that comprise the majority of the rock formations with sandstone having larger particles than either claystone or siltstone.

### Faults and Fault Displacement

A fault is a fracture or break in the earth, along which the rock on one side is moving (or been displaced) relative to the rock on the other side. The displacement can be lateral or vertical, or both (see Figure No. 2).

The Bay Area is located in one of the most seismically active areas on earth.

FIGURE NO. 2



(a) Sketch summarizing the terms used to describe faults. Fault plane: rupture surface (patterned area). Fault trace: intersection of earth's surface with fault plane (bold single line). Dip angle of the fault: acute angle between the horizontal and the fault plane (angle Θ)

(b) Reverse fault or thrust fault. Example: Clayton Fault

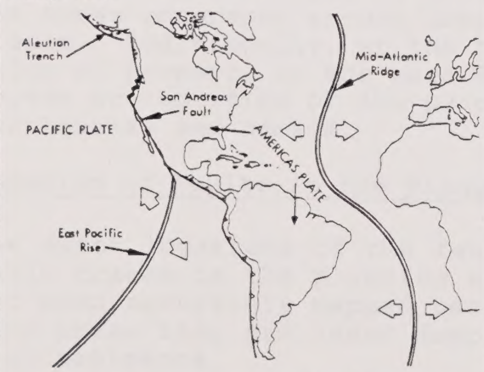
(c) Normal fault. Example: Midland Fault, radial faults on flank of Mt. Diablo

(d) Right lateral strike-slip fault. Example: San Andreas, Hayward, Calaveras Faults

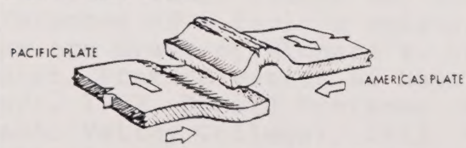
This activity is a result of being located on the boundary between the rock (or plate) forming the American Continent (see Figure No. 3). The latter, or Americas plate, is "drifting" southwesterly relative to the Pacific plate and is being forced to override the former. The main line of contact between the two plates is the San Andreas Fault System. The San Andreas Fault runs northwesterly through the Bay Area (see Figure No. 4). The fault trace approximately coincides with a line connecting Crystal Springs Reservior in San Mateo County with Tomales Bay in Marin County. In addition to the major faults feature of the San Andreas, there are many parallel faults caused by the general movement of the two great plates. Of particular concern to the Bay Area are the Hayward, Calaveras and Concord fault zones, also shown in Figure No. 4.

Faults are classified as active, potentially active, or inactive. The classification is based on the recency of fault movement. The Concord, San Andreas, Hayward faults and the Calaveras fault system up to Dublin are considered active. The Calaveras system north of Walnut Creek, including the Pleasant Hill area is considered inactive, but is of local concern because it is part of an active system.

FIGURE NO. 3

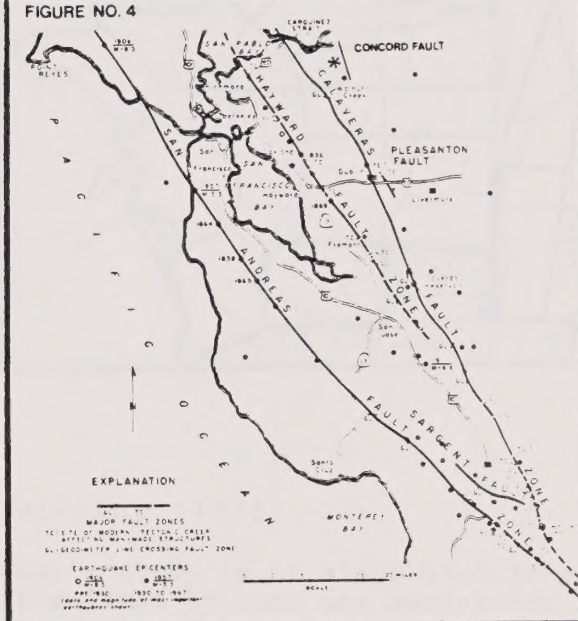



A. The earth's "crust" is composed of several large "plates". These plates are slowly being pushed across the surface of the earth, away from the mid-ocean ridge systems. California is situated on the western edge of the Americas Plate, with the San Andreas fault forming the boundary between the Americas and Pacific Plates. The high seismicity of California is a direct result of its location on the edge of a plate.




B. As the Americas Plate is shoved westerly, away from the Mid-Atlantic Ridge, it over-rides the Pacific Plate. Because of its location on the western edge of the Americas Plate, California has been subject to earthquakes, faulting and folding as the two plates collide and grind against one another. Movement of the Pacific Plate, away from the East Pacific Rise, accounts for the lateral (strike-slip) movement on the San Andreas fault.
Source: Contra Costa County Planning Department Illustrations.

FIGURE NO. 4




Active, or potentially active faults show evidence of having the potential for further relative movement - possibly during the life of a building. If the exact line along which a fault would move were known, damage from fault displacement could be minimized. However, such movement is presently impossible to predict.

The Calaveras Fault zone is active in the Hollister area and active traces are found on the west side of the San Ramon Valley and possibly as far north as Walnut Creek. It is possible, yet unproven, that the Concord Fault, which is active, may be an extension of the Calaveras system, and in turn may be re-

lated to the active Green Valley Fault further north. The best mapping to date indicates the Calaveras Fault zone extends northward to Walnut Creek and no further.

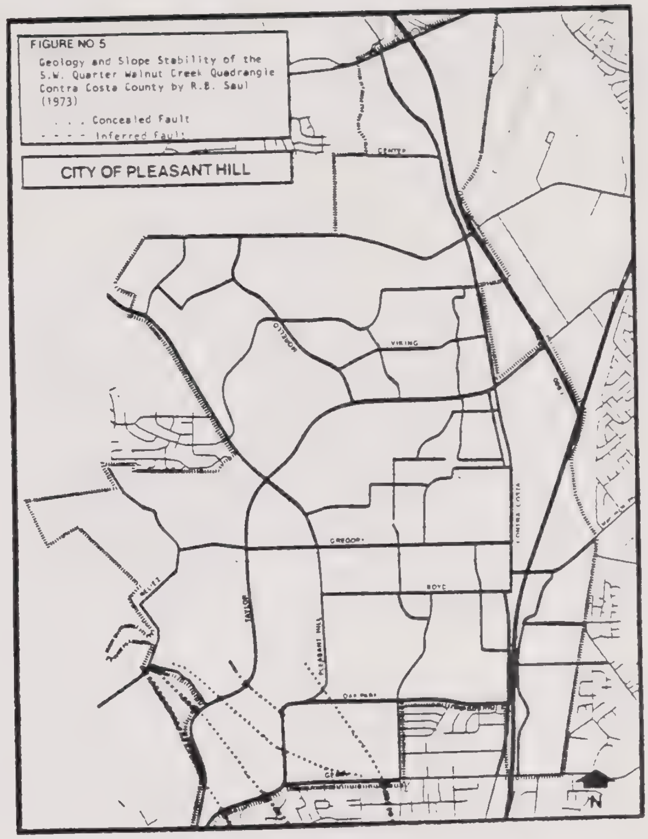
Within the Pleasant Hill Planning Area there are three inactive faults. Of these faults, two are centered around what is called the Calaveras Crush Zone. The most widely recognized of these faults is locally called the Franklin Fault. It is slightly west of the City limits and forms the southern edge of the crush zone. The northern edge of the crush zone is the Southampton Fault which runs through the City. The remaining fault found in the City is known as the Pacheco or Vine Hill Fault. Little is known about the Southampton or Pacheco Faults individually or their relationship to the Franklin Fault.

In addition to the faults found within the planning area, the Concord Fault, an active fault, is located slightly to the east of the City and is a major concern to the City. The fault touches the western edge of Buchanan Field and runs southeasterly through the Concord downtown area. Because this is a known active fault, it is within an Alquist-Priolo Geologic Hazards Zone. The purpose of this zone is to provide protection from the hazard of fault rupture by avoiding, to the extent possible, the construction of structures for human occupancy across active fault traces. Additionally, at the time of sales of property in the hazard zone, buyers are notified of the potential of earthquakes and damage.

<u>Location of Faults in the Planning Area</u>

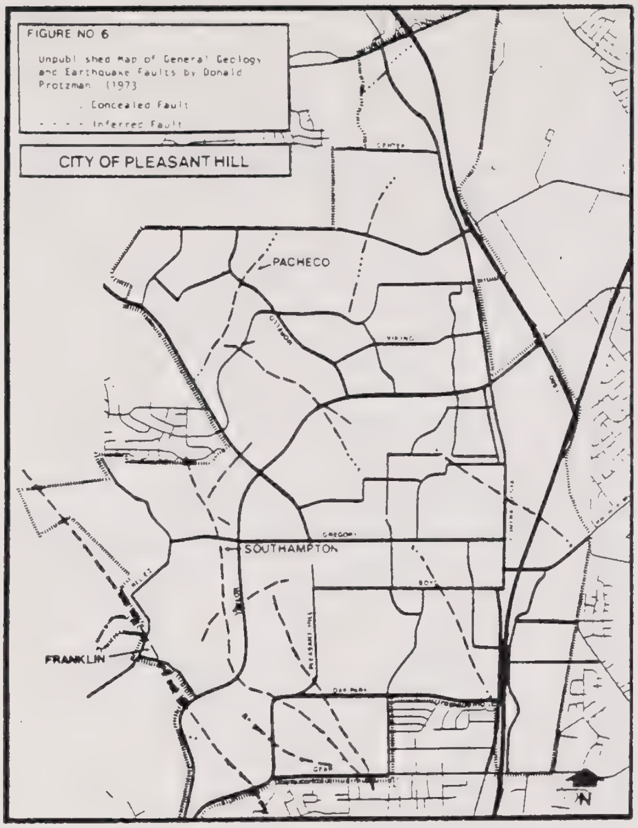
The exact locations of the faults and fault traces in the planning area have not been accurately mapped because in many areas they are under deep alluvial sediments.

As of October, 1980, there are no less than four maps indicating the locations of faults, fault traces and speculative inferences of a fault's existence. The maps are drawn by Richard B. Saul (Geologist, State Division of Maps and Geology), 1973, Donald Protzman (Geologist, Diablo Valley College), 1973, E. E. Brabb (Geologist, Contra Costa County Planning Dept.), 1976, and Thomas W. Dibblee, Jr. (Geologist, United States Geological Survey), 1980. Each of the maps are included and will be discussed in detail.




*Saul Map (1973):*

Saul's study is of slope stability as it relates to land use decisions. He found that Walnut Creek and the adjoining communities of Lafayette and Pleasant Hill are areas of moderately rapid urban growth. These communities lie in a region of widespread landsliding, or in close proximity to, the active Calaveras Fault Zone. In his mapping, Saul did not identify any visible faults in Pleasant Hill, because much of the true nature of the Calaveras Fault Zone in the Walnut Creek-Pleasant Hill area is obscured by alluvium, streets, and buildings. He finds evidence, however, that the zone is complex and contains many faults. Existence of the fault trace beneath the alluvium is indicated by topographical features northwest of Pleasant Hill Elementary School. The alignment of ridges, truncated spurs, valleys, swales, ravines, and landslides extends this tract northwest into the Briones Valley quadrangle. Saul's analysis terminates slightly north of Oak Park Boulevard and does not include the majority of the City. Saul's mapping can be found in Figure No. 5.



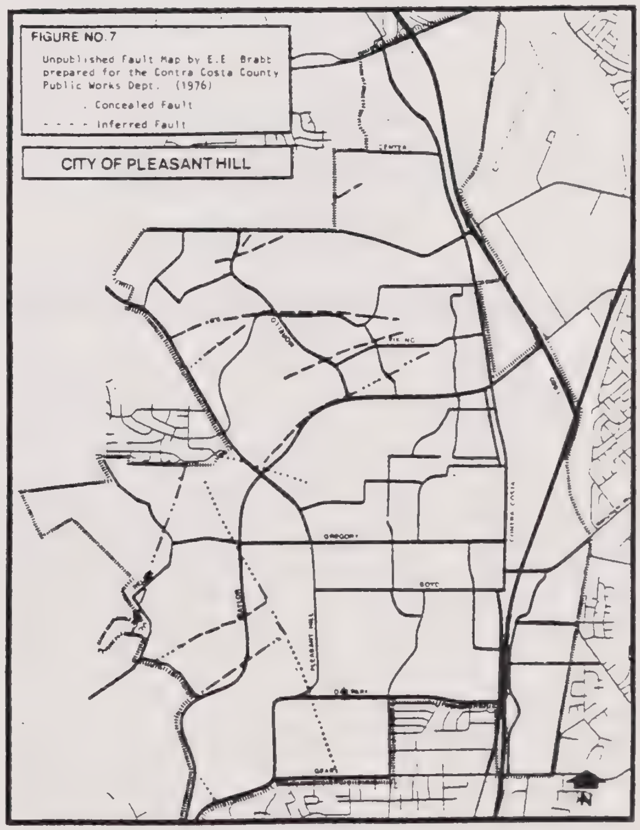

*Protzman Map (1973):*

The Protzman Map (Figure No. 6) is unpublished, and thus has not been reviewed by other professional geologists. The map was prepared for the City of Pleasant Hill in 1973, when staff was preparing a draft Seismic Safety Element. Protzman found faulting exists throughout Contra Costa County with few areas unaffected. Pleasant Hill is no exception to this finding. He believes there are three well-defined faults located within and adjacent to the city boundaries of Pleasant Hill. The major faulting occurs in a zone of deformation which is centered about the Calaveras Crush Zone. This fault zone is composed of two pronounced faults, the Franklin on the southwest side and the Southampton on the northeast side. Numerous minor cross-faults occur within and adjacent to this crush zone. The third major fault, the Pacheco or Vine Hill Fault, is a transverse fault which runs in a southwesterly direction from the tidal flats south of Suisun Bay, through Pacheco and into the hills, west of Pleasant Hill Road.

Both the Saul Map and the Protzman Map agree on an implied fault tract which exists next to the Pleasant Hill Elementary School. Protzman identifies this fault as the Franklin Fault and is seen in the same general location as Saul's.

*Brabb Map (1976):*

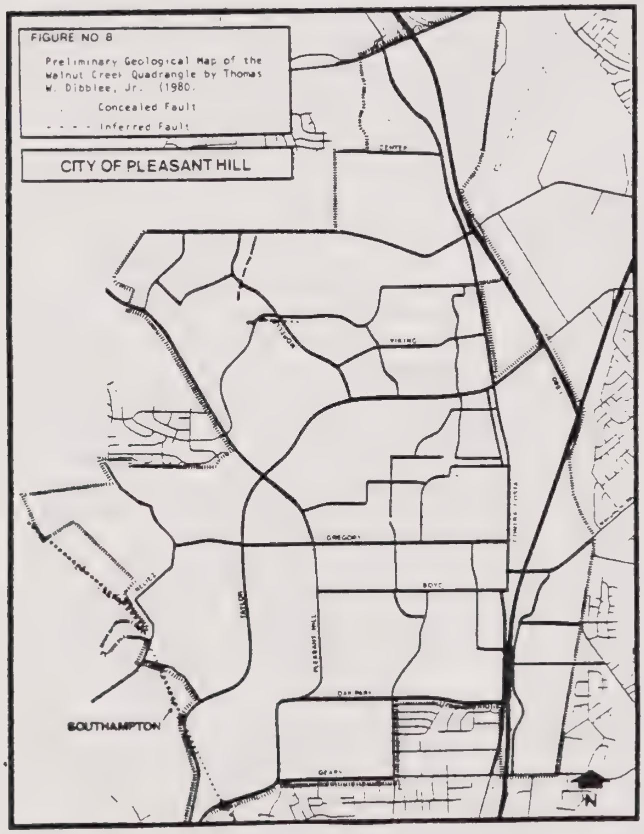
This map (see Figure No. 7) contains information from private oil and gas companies' geologists while they conducted field investigations for possible locations of energy sources. Brabb did this study for the Contra Costa County Public Works Department and has specified that the mapping did not encompass specific site investigations. This map is unpublished and like Protzman's Map has not been reviewed by other professional geologists.




Though the Brabb Map does not name specific faults, it is in general agreement with the mapping done by Protzman for both the Southampton and Franklin Faults. The areas where the two maps disagree are the exact locations of the Pacheco Fault, which is not shown in the City, and the various fault traces which cross the Calaveras Crush Zone.

*Dibblee Map (1980):*

This is the latest map (see Figure No. 8), and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature but is part of an "open file" of the United States Geological Survey and is being reviewed by professional geologists. Basically, Dibblee field checked locations where there are visible signs of a fault's location. Again, there is general agreement on the location of the Franklin Fault (which Dibblee has erroneously referred to as the Southampton Fault) and the trace of the Calaveras Fault identified by Saul. However, Dibblee's map does not extend the Calaveras Fault




trace as far as Saul or Protzman. Dibblee is also in substantial agreement with Protzman and Brabb on the location of the Pacheco Fault. Dibblee did not locate the Southampton Fault as did Protzman and Brabb because evidence of the fault, if it does exist, is under many feet of alluvium.

# SEISMIC SAFETY GOAL

TO REDUCE THE POTENTIAL FOR INJURY, LOSS OF LIFE AND DAMAGE TO PROPERTY DUE TO GEOLOGIC AND SEISMIC HAZARDS.

The Seismic Safety goal expresses a general theme and framework for the City to follow in providing our citizens a safe environment. While the goal states a major theme, it is the policies and implementation programs that provide the major commitments to obtaining the goal and thus is the essence of this element.

# POLICIES & IMPLEMENTATION PROGRAMS

There are several critical effects of seismic events (i.e., earthquakes, ground rupture, ground shaking, ground failures and tsunami and seiches) which require specific discussion in a Seismic Safety Element. Those are discussed in the first policy. In addition to discussing these critical effects, a summary of building types and critical use buildings is discussed in the second policy.

## POLICY A : GEOLOGIC HAZARD

*Ground Ruptures:*

There are several critical effects of seismic events (i.e., earthquakes, ground rupture, ground shaking, ground failures and tsunami and seiches) which require specific discussion in a Seismic Safety Element. These are discussed in the first policy. A summary of building types and critical use buildings is discussed in the second policy.

The faults within the Pleasant Hill Planning Area are not known to be active, and therefore, ground ruptures due to displacement is unlikely. It is possible that movement along a major active fault could trigger adjustments along the major fault traces, or minor cross faults and parallel traces, which could cause minor foundation damage.

The Franklin Fault's (the major fault that crosses into the planning area) relationship to the Calaveras system, which is active, is not completely understood. However, the Calaveras Fault is generally considered to be the main trace of the Calaveras system in northern Contra Costa County. Additionally, there are no insights into the displacement along this fault, which makes its true potential unknown. Of the faults existing in the planning area, it provides the greatest potential for rupture, but even that possibility appears remote.

The rupture of earth during an earthquake is dramatic and most attention is focused on this action, but the less dramatic problem of tectonic creep or fault creep is significant. The fault creep is the very slow movement along the fault which is unaccompanied by perceptible earthquakes, but might be manifested in curb displacement and cracked foundations or concrete. Protzman's evaluation notes several areas of deep alluvium where there is apparent creeping with accompanying curb displacement. Though the displacement is minor, prolonged movement could have a significant effect on improvements and structures.

It is generally accepted practice to exclude development over active fault traces. Yet, even inactive faults should be given consideration in the review of projects. The faults in Pleasant Hill's Planning Area are generally hidden under layers of alluvium, and therefore, difficult to locate. To the extent practicable, structures and vital services (i.e., water and gas lines) should not be constructed upon the suspected traces without an investigation by a licensed geologist.

As stated earlier, ground rupture along a fault is dramatic, although the effects are highly localized. The effects of ground shaking are considerably more widespread and cause the major earthquake damage.

*Ground Shaking:*

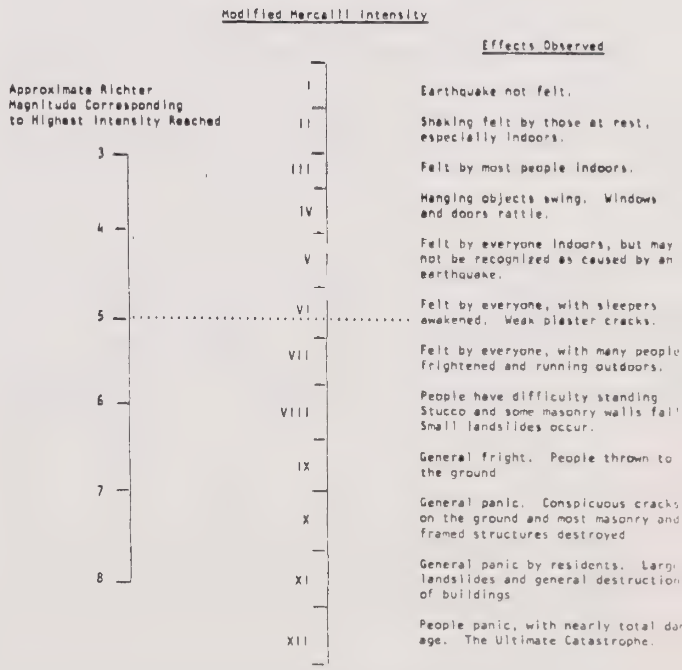
Unlike ground rupture, all structures in Pleasant Hill's Planning Area could be affected, to some extent, by ground shaking - the movement of the earth due to an earthquake. The affects of local seismic ground shaking depends on two key factors; first, the characteristics of the earthquake, and second, the local ground conditions.

Ground shaking is affected by the strength of the energy released, the duration of the earthquake and distance of the site from the earthquake.

Earthquakes are typically described by two basic measurements of strength. The first accepted method of classifying an earthquake's strength is according to its impact on people, which is called an earthquake's "intensity." The most commonly used method of such a system is the "Modified Mercalli Scale" (see Figure No. 9) which assigns Roman numerals to earthquakes on a scale of I to XII.

FIGURE NO. 9

EARTHQUAKE MEASUREMENT CORRELATION




Approximate relationship of Modified Mercalli Intensity to Richter magnitude showing an earthquake having a Richter magnitude of 5.0 would be expected to have a maximum intensity of VI on the Modified Mercalli Scale.

Source: Pleasant Hill Planning Department

An earthquake with a rating of "I," the lowest intensity, cannot be sensed at all by people, while a "XII" rating earthquake, the highest, would destroy most buildings and distort the landscape.

A more modern system of measuring an earthquake's strength is according to the "magnitude" of energy released and expressed on a mathematical scale. The Richter Scale is the most common system and utilizes a logarithmic scale. Again, referring to Figure No. 9, the relationship between the Richter Scale and the Modified Mercalli Scale is shown.

The intensity of an earthquake effecting the Pleasant Hill Planning Area can be judged by the potential of the nearby faults. Again, none of the faults that are within the planning area are likely to cause an earthquake, and thus, are not listed in Figure No. 10, which approximates the earthquake potential.

FIGURE NO. 10

APPROXIMATE PROBABILITY OF OCCURRENCE OF EARTHQUAKES ON SELECTED BAY AREA FAULTS

(50-year period)

| Causative Fault | Richter Magnitude | Approximate Probability of Occurrence (over a 50-year period |
|---|---|---|
| San Andreas | 7.0-8.0 | Likely |
| | 8.0-8.5 | Intermediate |
| Calaveras | 6.0-7.0 | Intermediate |
| | 7.0-7.5 | Intermediate - Low |
| Concord | 5.0-6.0 | Likely |
| | 6.0-7.0 | Intermediate - Low |

LIKELY: Greater than 50% probability of occurrence
INTERMEDIATE: 15 - 50% probability of occurrence.
LOW: Less than 15% probability of occurrence.

Source: Contra Costa County Planning Department Estimates

There is little doubt the planning area will be subject to the effects of an earthquake within the next fifty years. The distance of the epicenter, the surface location directly above the center of the earthquake to the City will have bearing on the local effects. For example, the October 23, 1955 earthquake on the Concord fault (magnitude of 5.4) had a Modified Mercalli rating of VII. Because of this earthquake, windows broke, some plaster cracked and heavy furniture moved in Walnut Creek. But, in Brentwood, the same event had a Modified Mercalli rating of V with many people becoming frightened and some small objects, such as dishes, broken. In Sacramento, the earthquake was barely felt. It is currently difficult to estimate the maximum intensity of a projected event in Pleasant Hill, and much of the local intensity will be based on the underlying geology.

Each geologic formation responds to earthquake shock waves differently. Because of the difference in responses, determining a reliable method of ground shaking effects, what most people and structures react to during an earthquake, is probably one of the most difficult tasks in determining the risk of development. In general, bedrock formations are considerably less susceptible to ground shaking than alluvium formations. Additionally, older alluvium formations are more firmly consolidated and less susceptible to ground shaking than younger alluviums.

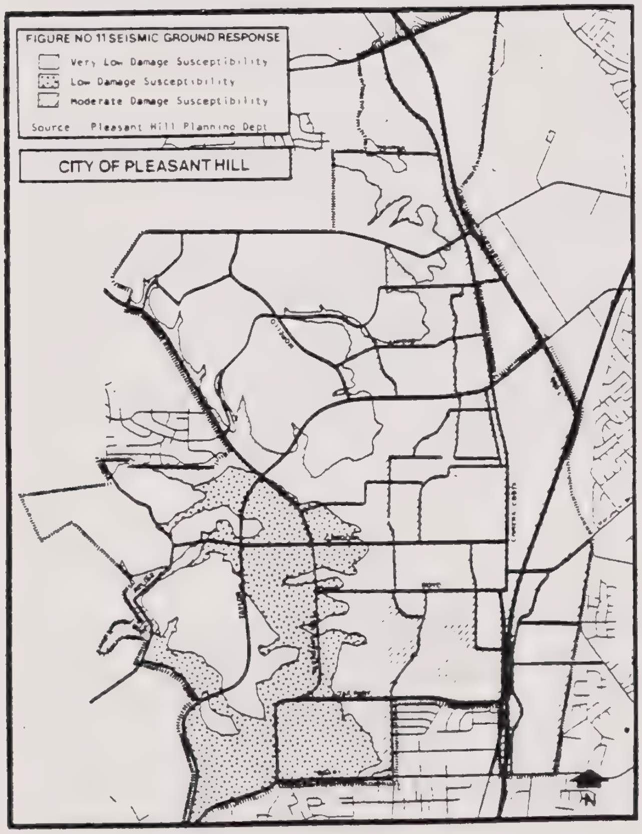
The difference in seismic reactions stems mainly from the different amplifications of the shock waves of each ground type. Bay muds and young alluviums magnify the waves to a greater degree in both actual movement and duration than bedrocks. The magnification in shaking causes an increased "predominate period" for a building and the ground on which it rests. The "predominate period" is a measurement of the time between seismic wave peaks, the time when a building is most vulnerable to damage. The predominate periods of a building can be related in a very general way to its height or number of stories. Taller buildings have a longer predominate period (2 seconds or more). Therefore, they are subject to greater damage where they occur on ground with a longer predominate period (thick, saturated sediments or young alluvium). Conversely, one or two story buildings with a short predominate period may have more trouble on firmer ground.

Again, this generalized theorem varies widely because of the other factors that may contribute to a damage potential magnitude of a particular earthquake; distance and direction from the epicenter and causaltive fault, duration of shaking, and structural integrity of the buildings.

In a most general fashion it can be stated that first, low, rigid buildings (one to three stories) can be expected to receive more damage on the firmer ground in the hills than on the thicker alluvium in the flat lands. Secondly, low, rigid buildings are more susceptible to damage from a moderately large earthquake at short distance than from larger earthquakes at greater distances. Thus, a moderately distance earthquake on the Concord or Calaveras Fault would likely do more damage than a larger earthquake on the San Andreas Fault. Finally, the

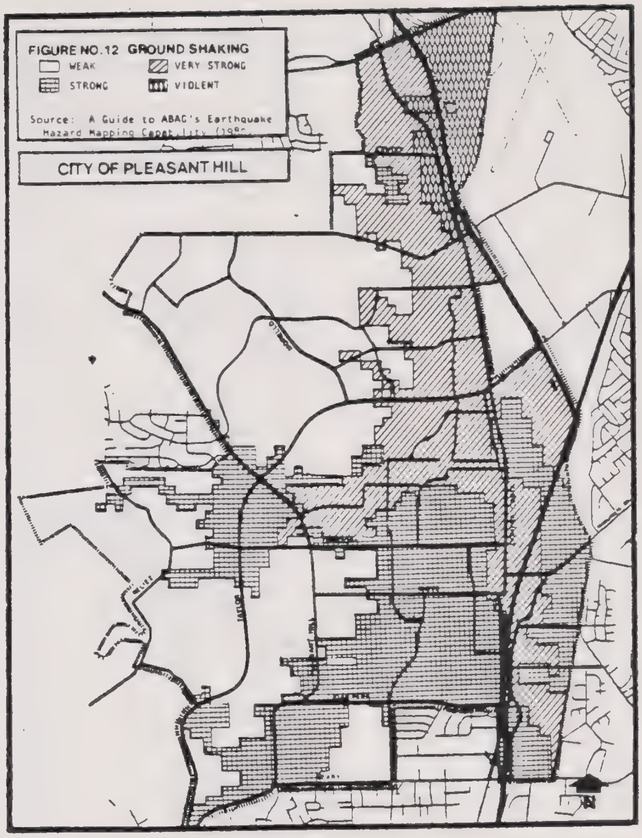
type of building construction can be directly related to damage. One story, wood-frame buildings are least susceptible to damage, regardless of soil conditions, and unreinforced masonry buildings are most susceptible.

The Pleasant Hill Planning Area consists primarily of two types of bedrock and alluvium. The relative response to an earthquake is shown in Figure No. 11. Both of the bedrocks have the lowest damage susceptibility with sound structures sited on firm foundation material which will respond well.




Each of the deposits will respond slightly differently to an earthquake, but will generally remain stable. With the predominate wood-frame construction, there appears to be a low or moderate susceptibility to shaking.

A major factor effecting the performance of alluvium is its thickness. Normally, this data is obtained from oil and water drillings and geologic mapping records. In the Pleasant Hill Planning Area, data is relatively scarce and unreliable. Therefore, there has not been any specific site thickness mapping. The lack




of map information does not have a real significance because what information has been developed indicates the alluvium depth is less than 150 feet and well compacted.

The Association of Bay Area Governments (ABAG) in March, 1980 released a "Guide to ABAG and Earthquake Mapping Capability," which mapped, by computer, the impacts of earthquakes. Of particular concern is the intensity map (see Figure No. 12) which combined information on faults, attenuating geology and damage from previous earthquakes. The map indicates the highest earthquake intensity appearing in an area from any of the active faults to create a map showing the maximum intensity regardless of fault source.

Figure No. 13

Groundshaking and Wood-Frame Buildings Damage

| Shaking | Percentage of Damages |
|---|---|
| Very violent | 16 |
| Violent | 12 |
| Very strong | 5 |
| Strong | 2 |
| Weak | 2 |

The report provides a general relationship between maximum ground shaking intensity and maximum percent damage to wood-frame dwellings. Figure No. 13 indicates the relationship.

As can be seen in Figure No. 12 & 13 that area most susceptible to ground shaking will be in Pacheco and will specifically move the mobile home parks in that area. Otherwise, minimal damage can be expected from a major earthquake in most of the planning area.

In summary, the ground conditions are excellently suited for the type of low, wood-frame structures found in Pleasant Hill.

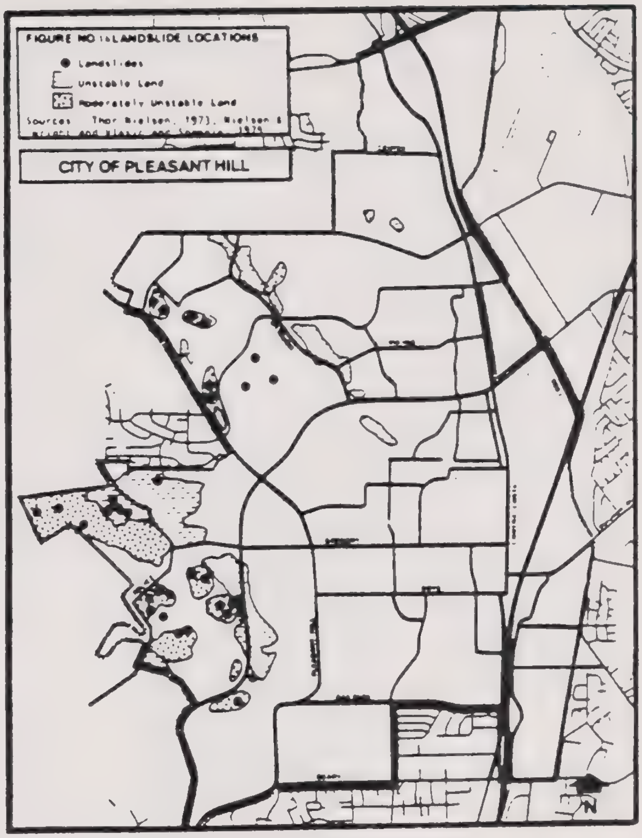
*Ground Failure:*

Ground stability, or the inability of ground materials to provide a stable foundation for buildings, is a concept involving several more specific ground reactions, including landslides, liquefaction, sensitive soils, differential subsidence and expansive soils. The problems of sensitive soils and differential subsidence are nonexistent in Pleasant Hill.

*Landslides:*

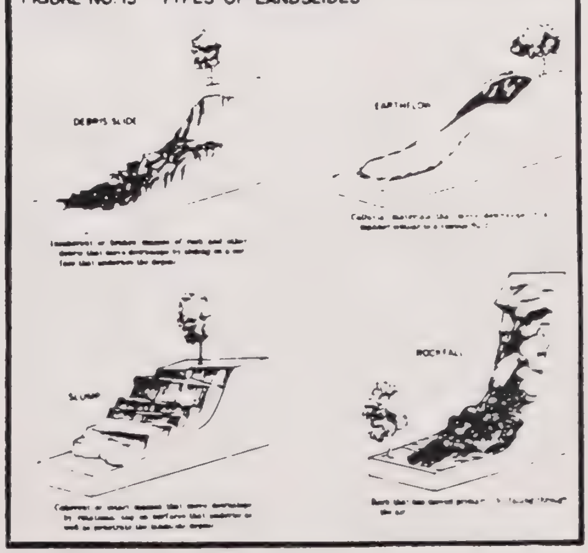
Landslides are the most common geologic problem to development and are the principal year-to-year cause of damage to public facilities and private property. Figure No. 14 indicates the general locations of landslides in the planning area. More specific maps are available and ABAG is expected to develop a model in 1981 which will locate land which is susceptible to slides. Existing information on the location of known slides indicates that the parcels west of Morello Avenue and Taylor Boulevard are most susceptible to landslides. Development in this area should have a soil investigation prior to any development.

Sliding is an erosive process involving the downhill movement of a mass of soil. Figure No. 15 shows the four most common types of landslides in the Bay Area. The rate of movement ranges from several miles per hour in the cases of wet, weak rocks on steep slopes, to only inches per year (creep).




The potential for seismically induced landslides is high, in some hillside areas. The relationship between earthquake stresses and the lateral and vertical motion of marginally stable slopes can induce ground failure, thus a landslide. The potential is even more prevalent when the earthquake follows a rain in which the land has become saturated.

FIGURE NO.15 TYPES OF LANDSLIDES



Besides the identified hillside landslide areas, there is the potential for landslides along creek and stream channels. The areas with steep eroded channels, such as Contra Costa Channel and the channel around the Ellinwood property, have a tendency to slide under lateral forces. Care should be taken to place buildings far enough from these channels so as to not place additional pressure on the banks which would significantly increase the potential for a slide.

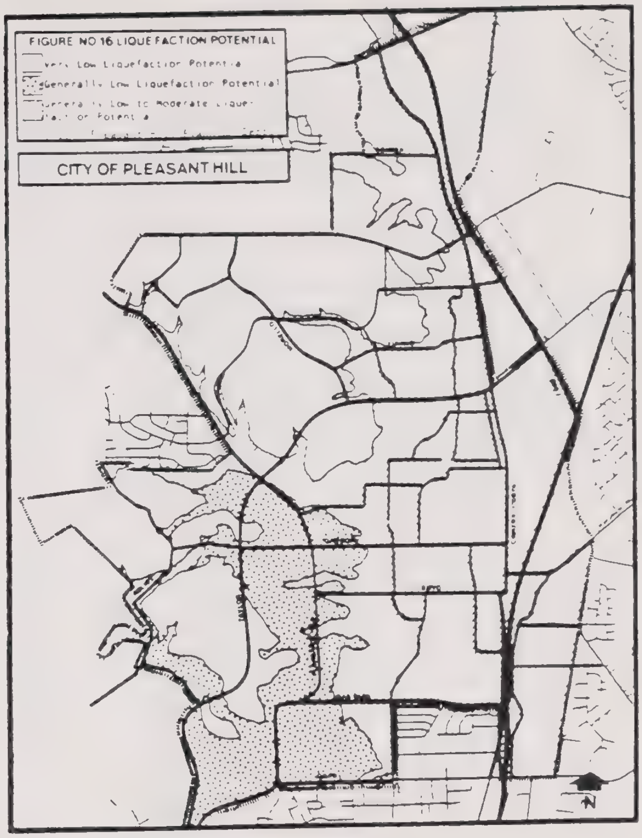
### *Liquefaction:*

In addition to the visible action of landslides, there is the potential problem of liquefaction. Liquefaction is the process where materials within the soils, the sands silts, coherence or strength is reduced and the particles are virtually suspended, similar to quicksand. This loss of strength leads to a condition in which buildings can sink, or float, on the unstable underlying earth.

The liquefaction potential maps are based on the general underlying materials past performance under earthquake conditions. The City's map contains data prepared for the Contra Costa County Seismic Safety Element. This map is only intended to designate broad areas where liquefaction is suspected. Figure No. 16 indicates the potential for liquefaction in Pleasant Hill. The County's information is strongly supported by a recent ABAG Earthquake Hazards mapping. Both mappings indicate the potential for liquefaction is extremely low in Pleasant Hill and should not limit development in the City.

### *Expansive Soils:*

Expansive soils are soils that contain clays which expand when wet and contract when dried, thus, causing problems to building foundations. The Soil Conservation Service completed a countywide mapping of types and characteristics of soils. Their analysis indicates most of the alluvium soils (the flat valley) in the City have a moderate to high shrink/swell potential and the soils in hills generally have a low to moderate shrink/swell potential, but there are some hillside areas of high shrink/swell potential.




In the flat areas, the higher rated soils can cause heaving, cracking, and break-up of pavements and concrete slab foundations. Removal of such soils from hillsides or ridgetops can expose more impervious material to rain, and induce sliding because of increased ground water. These soils are also susceptible to creeping, very slow downslope movement, since they tend to shrink downhill and expand downhill. Any site with soils with shrink/swell potential should be reviewed by a geologist or soils engineer.

### *Tsunami:*

Tsunami are large ocean waves, generated by rapid changes, usually in elevation of large masses of earth and water. These waves are often incorrectly referred to as tidal waves. The largest recorded tsunami in the San Francisco Bay was the wave caused by the Alaskan Earthquake in March, 1964. This wave reached a height of 7.4 feet at the Golden Gate, but was reduced to one-half that size by the time it reached Richmond. The available data indicates a rather systematic attenuations of wave height from the Golden

Gate to the head of the Carquinez Strait.

The best available data indicates there is an extremely low potential for any areas in Pleasant Hill to be inundated by tsunami waves due to the distance from Suisun Bay and the potential for wave action to extend that distance from the ocean.

*Seiches and Dam Failures:*

Seiches are earthquake-generated waves within enclosed or restricted bodies of water such as lakes and reserviors. They may be likened to the sloshing of water in a bowl or bucket when it is shaken or jarred. There are no bodies of water large enough in the Pleasant Hill Planning Area to be effected by a seiche.

Dam failures can be a result of a seiche or the failure of large masses of earth that might be broken loose as the result of an earthquake. There are no large dams located in Pleasant Hill which could effect the City, but minor inundation may occur from the failure of either the Lafayette Dam or Walnut Creek Clearwater to cause substantial flooding in Pleasant Hill.

In addition to large dams, the City has several water utility storage tanks which are considered as minimal risks; nevertheless, there is the potential for injury and property loss for properties located in close proximity to those tanks should they fail. There is no legislation that requires preparation of inundation maps, thus the extent of flooding is unknown. With any new facilities or expansion of current facilities, the City should require the Water District to prepare inundation maps and drainage plans in case of a seismic event.

**POLICY A: GEOLOGIC HAZARDS**

**Ensure development within the City which recognizes and respects the geologic constraints of the land.**

## IMPLEMENTATION PROGRAMS

A. 1. The City Planning Department should maintain several files including (1) available geological maps that indicate faulting and ground failure, and (2) maps and reports of all soil surveys, studies and borings to aid in research of previous investigations.

A. 2. The subdivision ordinance should be amended to require that any parcel or parcels with potential geologic hazards shall be reviewed and a geologic report filed with a person or persons licensed to practice in engineering geology.

A. 3. The City shall contract with a geo-technical consultant to review all geologic reports, and advise City staff on necessary mitigation measures to ensure safe developments.

A. 4. The City shall require a geotechnical consultant to review and approve all grading, site preparation and soils compaction on sites which show a high shrink/swell potential to ensure the site meets accepted engineering standards.

## POLICY B: STRUCTURAL SAFETY & RISK

The State requires the Seismic Safety Element to include a comprehensive evaluation of the buildings and structures in the community. Seismic safety not only implies identification of geologic hazards to ensure that risks are minimized in new developments, but also involves assessing the consequence of a severe earthquake on existing developments. Pleasant Hill, because of the predominance of wood-framed, single family dwellings, relatively new commercial building, and few industrial uses, has a low seismic risk potential.

The level of risk to a building that can be accepted by the community differs by the use. If a hazard or potentially hazardous condition is identifed, public policy must determine what must be done to reduce the hazard and balance the possibility of damage against public costs and benefits. Determining the proper balance is a difficult task.

The amount of risk that can be tolerated by a community for any given building depends on the effects of the damage in an emergency situation, the use of the building, and number of people potentially injured in the building. It must be recognized there is no risk-free environment. Certain uses can be allowed only very slight risk potential and their placement and engineering is extremely critical. Included in these are energy plants and weapon stations. Other uses and buildings, such as single family wood-frame houses, performance acceptability under most conditions and thus their placement is not as critical and greater risks may be taken and still be acceptable.

The lowest level of allowed risk for those structures whose failure might be a catastrophe if damaged, such as energy plants, a large dam or buildings containing toxic material. The second level of building which is extremely important, but where slightly more risk can be allowed, are those structures whose need is critical after a disaster, such as the Police Station, hospitals, and Fire Department. Building failure in either of these first two categories would effect populations substantially greater than their occupancy. The next level of allowable or tolerable risk is for high-occupancy buildings whose failure would injure a large number of people or whose use after a disaster could be needed, such as schools and medical offices. Finally, there is the vast majority of buildings which have an "ordinary level of acceptable risk." "Ordinary level of acceptable risk" means there would be no normally expected structural damage during a moderate earthquake and the building should withstand a major earthquake without substantial structural damage. With either a moderate or major earthquake some nonstructural damage is acceptable, such as cracked plaster. In general, it can be stated the risk potential is very acceptable with no building dangerously positioned and the City should function reasonably well following the largest anticipated earthquake.

### Buildings

*Critical Hazardous Use Buildings:*

There are buildings and structures whose failure would cause further damage to the community than had already occurred. There are no buildings of this type in the community.

*Critical Emergency Buildings:*

Critical emergency buildings are those whose function is essential for responding to an emergency situation. The critical buildings in Pleasant Hill include City Hall, the Police Station, three Fire Stations and a medical center. All of the fire stations and the medical center are relatively new buildings and should be able to survive an earthquake. The Fire Station on Geary has a map fault trace near or under the building, and this condition should be considered in any disaster preparedness plan.

The City Hall, built following World War II, is in sound structural condition, and should withstand a major earthquake. During February, 1981, the Police Department moved to a newly-constructed building on Civic Drive. Because of its newness and location, the new Police Station should function acceptably in an emergency.

Because very few emergency buildings are located in the planning area, it is extremely important to maintain access to hospitals in Martinez, Concord, and Walnut Creek. This situation necessitates exceptionally reliable communication facilities to Martinez and the emergency response facilities of the County.

### *High Priority Large Occupancy Buildings:*

There are two types of these buildings that need to be identified; first, there are the potential meeting places which could be the focus of community activity, such as schools and recreational facilities. Second, there are those large use buildings which may require special services in an emergency. This type of building includes convalescent homes, theatres, shopping centers, and large apartment buildings.

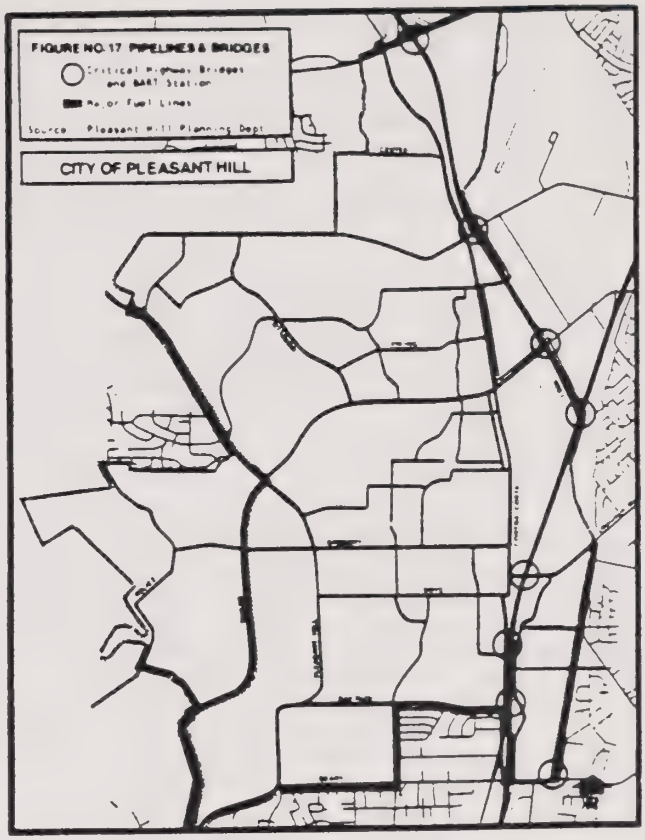
There are 13 school buildings in the City, including schools which have closed and Diablo Valley College. All but the Pleasant Hill Elementary and Pacheco School are post-Field Act (i.e., built after 1933, when special state laws were enacted governing the design of school buildings to resist earthquakes). This means that the post-1933 schools are built to special standards which are intended to make them relatively earthquake resistant. The other two schools have had substantial upgrading over the years and appear structurally sound. Pleasant Hill Elementary is indicated as being near or over an inactive earthquake fault. The school district should monitor this building's condition with more concern than other schools.

The remaining high priority buildings are all relatively new, with most built in the last 12 years. The oldest structure, the Contra Costa Center, appears to be in sound condition. It is not anticipated that any of these buildings would receive any severe damage due to any earthquake.

## TRANSPORTATION AND UTILITIES

### *Transportation*

There are two principal transportation routes which are considered vital to the City (and to the County as a whole), particularly in the event of a disaster - Highway 680 and BART. Interstate Highway 680 runs through the City, while BART touches the City only on its southwesternmost corner. Intersections of these routes and other arteries often involve a bridge or overpass. These structures are generally designed to withstand a certain level of seismic shaking, but design parameters are not always adequate. Considering ground




shaking done, the San Fernando 1971 Earthquake and the 1980 Humboldt County Earthquake have indicated these structures as built in California will be especially subject to damage. Because of the type of seated connections at the abutment, it must be expected that some of these might fail during a major earthquake.

The BART Station and tracks only slightly cross into the planning area, and the amount of expected damage in the City of Pleasant Hill is insignificant compared to the possible damage to the entire system.

Critical intersections for both Highway 680 and the BART system are shown in Figure No. 17.

### *Fuel Pipelines*

There are several fuel and gas lines which traverse the planning area, these are shown in Figure No. 17. The major pipelines include two 10-inch fuel pipelines, one within Pleasant Hill Road and Taylor Boulevard, and one within the Southern Pacific right-of-way. The pipeline in Pleasant Hill Road and Taylor Boulevard continues through to Lafayette.

The Southern Pacific Pipeline Company indicates a fuel line exists in the right-of-way on the eastern edge of the City. The line is primarily used to provide various refined fuels to the Santa Clara Valley, and particularly to San Jose Municipal Airport.

Both of these facilities have been designed with considerations for potential seismic hazards and the pipelines have been constructed to conform to American Petroleum Institute Standards. If breaks occur on these lines, pressure-sensitive valves will automatically shut-off and isolate the breaks.

*Telephone*

The Pacific Telephone and Telegraph Company provides communication service to Pleasant Hill. The planning area is served by two telephone switching offices. Because of the large number of duplications in telephone lines, service is difficult to disrupt. If a major earthquake occurs, the telephone system could be interrupted for the following 24 hours. If the equipment itself is not damaged, the large number of calls immediately following an earthquake may result in an overload which could temporarily halt service.

*Electric*

Electric power is supplied to the planning area by Pacific Gas and Electric Company from its generating plant in Pittsburg. The transmission lines from this plant cross the bay lands and may be subject to failure during severe ground shaking. Electric transmission and distribution circuits are equipped with various automatic control devices designed to return the system to a relatively normal condition as soon as possible after an interruption.

## POLICY B: STRUCTURAL SAFETY

**Ensure buildings and structures are safe from seismic and geologic hazards.**

## IMPLEMENTATION PROGRAMS

B. 1. Participate with the County in a hazardous structure study to inventory all high occupancy, critical, and older structures and develop a program to eliminate.

B. 2. The Building Department will inform applicants for building plan check and permit about potential expansive soils and landsliding and, if necessary, require site specific soils reports prior to the issuance of a building permit.

B. 3. The City shall update its building codes to conform to the latest Uniform Building Code requirements for seismic safety.

## GLOSSARY OF GEOLOGIC TERMS USED IN THIS REPORT

Active Fault: A fault which shows evidence of movement during the last 11,000 years.

Alluvium: A general term for the sediments deposited in river beds, flood plains, lakes and estuaries during relatively recent geologic time.

Cretaceous System: The uppermost of the 3 Mosozoic systems, including chalk as its most characteristic formation.

Differential Subsidence: An occurrence in which two adjacent land areas subside by different amounts.

Earthquake: An event caused by the rapid movement of rocks along a fault and producing ground shaking.

Epicenter: The geographical location of the point on the surface of the earth that is vertically above the earthquake focus.

Fault: A fracture (or break) in the earth along which the rock on one side has moved (or has been displaced) relative to the rock on the other side.

Fault Creep: A very slow movement along a fault which is unaccompanied by perceptible earthquakes.

Fault Trace: The intersection of a fault and the earth's surface, as revealed by dislocation by fences and roads, and by ridges and furrows in the ground.

Geologic Hazards: Those natural processes which, while altering the earth, present a threat to the health and safety of man, his property, and his community.

Geology: The science which studies the earth through studying the rocks of which it is composed, the fossils in these rocks, and the processes which alter it.

Ground Water Table: The upper surface of the zone of water saturation within the ground.

Ground Shaking: The shaking of ground due to an earthquake.

Inactive Fault: A fault which cannot be classified as either active or potentially active.

Intensity: A nonlinear measure of earthquake size at a particular place as determined by its effect on persons, structures, and earth materials. The principal scale used in the United States today is the Modified Mercalli, 1956 version.

Landsliding: The perceptible downward sliding or falling of a relatively dry mass of earth, rock, or mixture of the two. Often loosely used to also include sliding of wet earth masses such as mudslides and earthflows.

Liquefaction: A process by which a water-saturated sand layer loses strength when shaken, leading to a quicksand condition.

Lower Tertiary: The lowest general stratigraphic group of the Tertiary succession (Ecocene).

Magnitude: The rating of a given earthquake is defined as the logarithm of the maximum amplitude on a seismogram written by an instrument of specified standard type at a distance of 62 miles from the epicenter. It is a measur of the energy released in an earthquake.

Potentially Active Fault: A fault which shows evidence of movement during middle to Late Pliocene time (5 million to 3 million years ago) or is closely linked to faults considered active outside of the planning area.

Predominant period: A number representing the time between seismic wave peaks to which a building on the ground is most vulnerable. Usually measured in seconds.

Rock Structures: Those features of rocks produced in rocks by movements after deposition, such as folding of rock layers.

Sandstone: A sedimentary rock formed from sands that have been cemented together.

Sedimentary Rocks: Rocks (commonly layered) formed by the accumulation of air or water borne sediments.

Sediments: Particles of rocks, such as sand, silt, or clay.

Seiches: Earthquake-caused waves in lakes.

Seismic: Pertaining to an earthquake or earth vibration, including those that are artifically induced.

Sensitive Soils: Fine-grained cohesive soils (clays such as San Francisco Bay muds) whose strength, when shaken, is far less than when undisturbed. (They are gelatin-like.)

Settlement: The compaction of loose soils (may be associated with ground shaking).

Siltstone: A sedimentary rock composed largely of silt-sized particles.

Shale: A sedimentary rock composed largely of clays that has developed fine layers.

Sliding: A perceptible downward movement of either wet or dry soil or rock.

Subsidence: A down-dropping of a large area of land or a lowering of elevation of such an area.

Tectonic: Pertaining to or designating the rock structure and external forms resulting from the deformation of the earth's crust. Pressures causing such deformations often result in earthquakes.

Tertiary: A segment of geologic time beginning 70 million years ago and ending 3 million years ago.

Tsunami: A sea wave produced by large areal displacements of the ocean bottom, often the result of earthquakes or volcanic activity. Also known as seismic sea waves.